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GB 1588993
GB 0761263
GB 0377542
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(71) Applicants
Racal Safety Limited (United Kingdom),
No. 1 Building,
Beresford Avenue,
Wembley,
Middlesex HA0 1QJ
(72) Inventors
Raymond Odell
Richard Keven O'Connor
David Buckley Easton
Stephen James Davies
(74) Agent and/or
Address for Service
A. A. Thornton & Co.,
Northumberland House,
303-306 High Holborn,
London WC1V 7LE

(54) **Powered air supply unit for respirators**

(57) A powered air supply unit for a respirator for connection by a flexible hose to a facepiece or headpiece comprises a generally rectangular housing 1 with a stepped periphery in which one or more filler units (25) are located. A removable apertured protective cover (4) retains the filter unit or units in opening (3) of the housing. Within the housing (1), a centrifugal pump (13) with a d.c. motor (14) connected directly to the shaft of the pump are provided side by side with a battery housing for batteries to drive the motor. The inlet (21) of the pump opens within the housing and the outlet (20) of the pump is connected directly to an outlet (6) in one side wall of the housing and which is intended for connection to the flexible hose. The filter unit may comprise multiple layers including sintered or granular carbon separated by mesh (26). The headpiece can include a rigid or flexible head protector with a fixed or pivoted mask and air ducts for the filtered air.

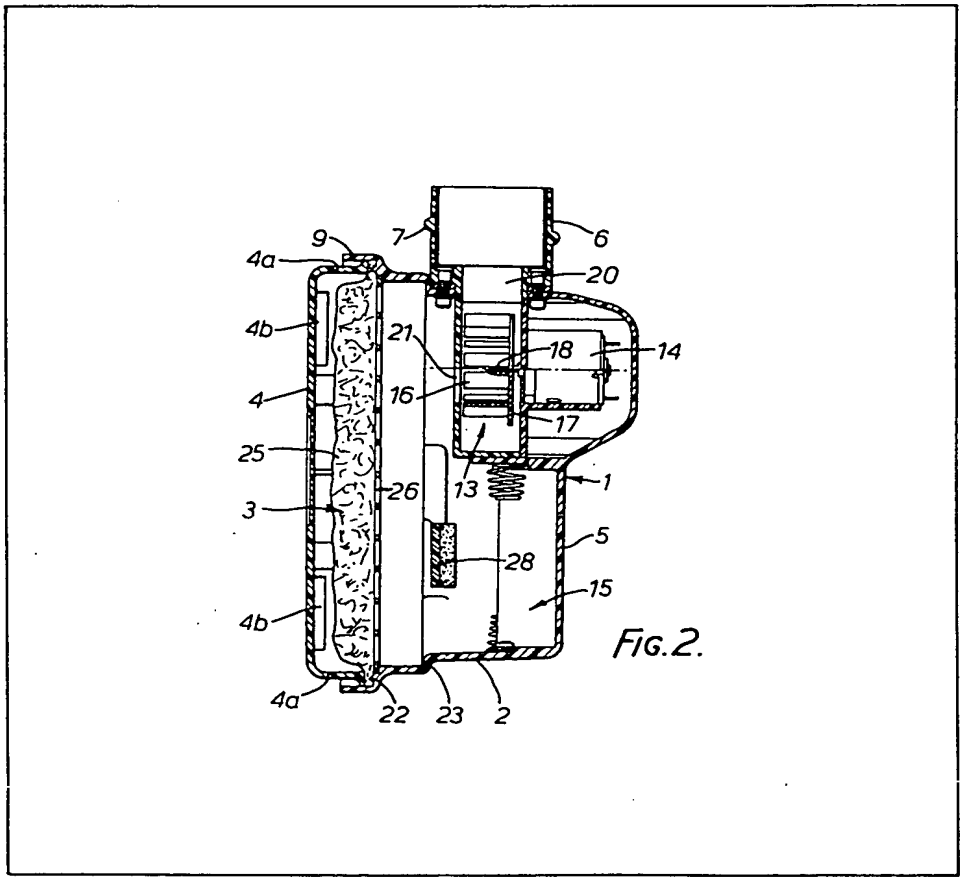

FIG. 2.

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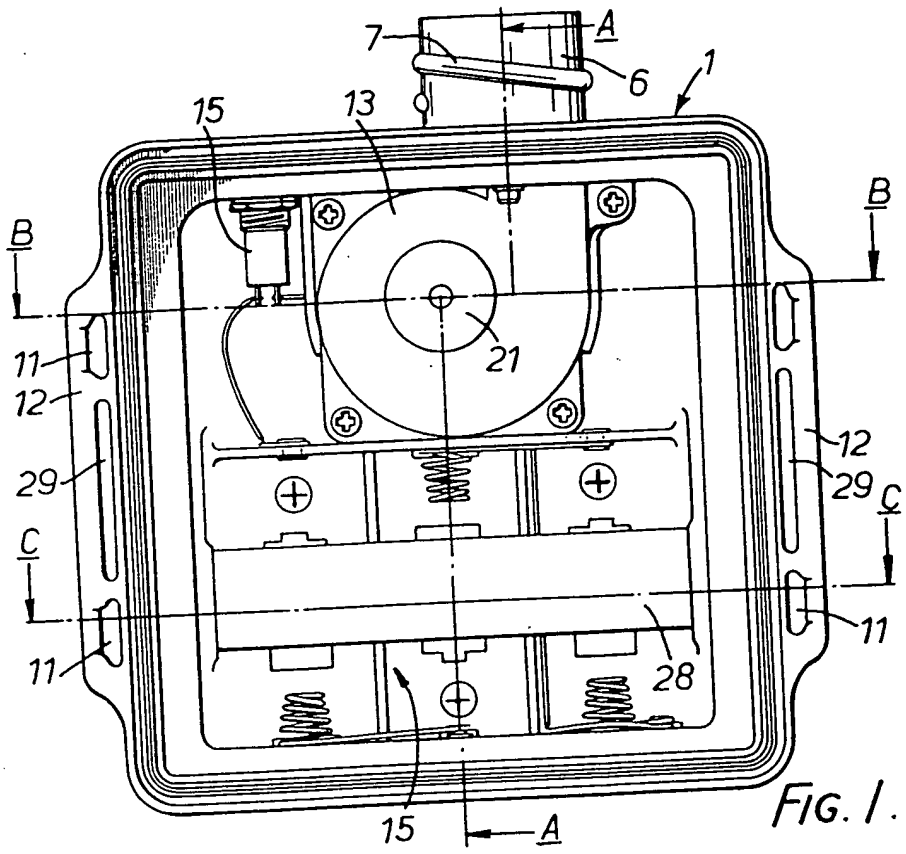

7
A
6
1
15
13
B
B
11
12
21
12
29
29
C
C
11
11
28
15
A

FIG. 1.

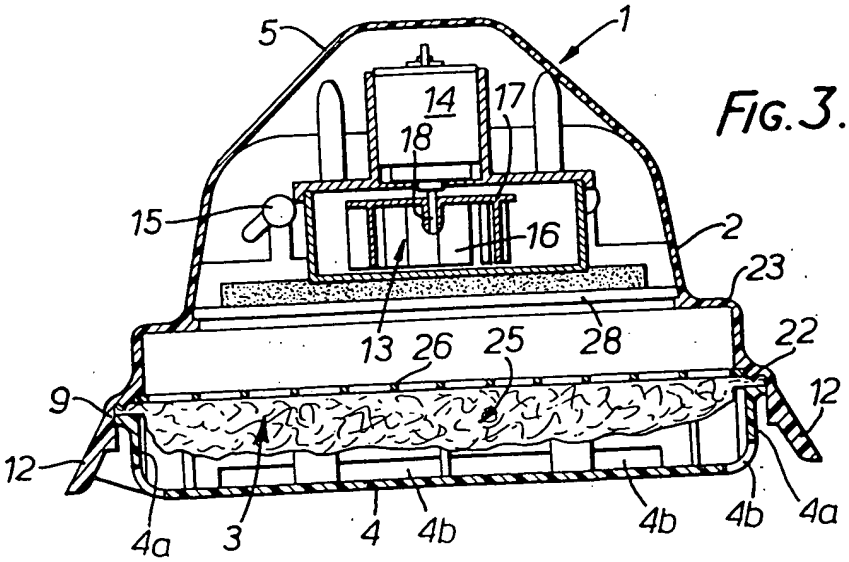
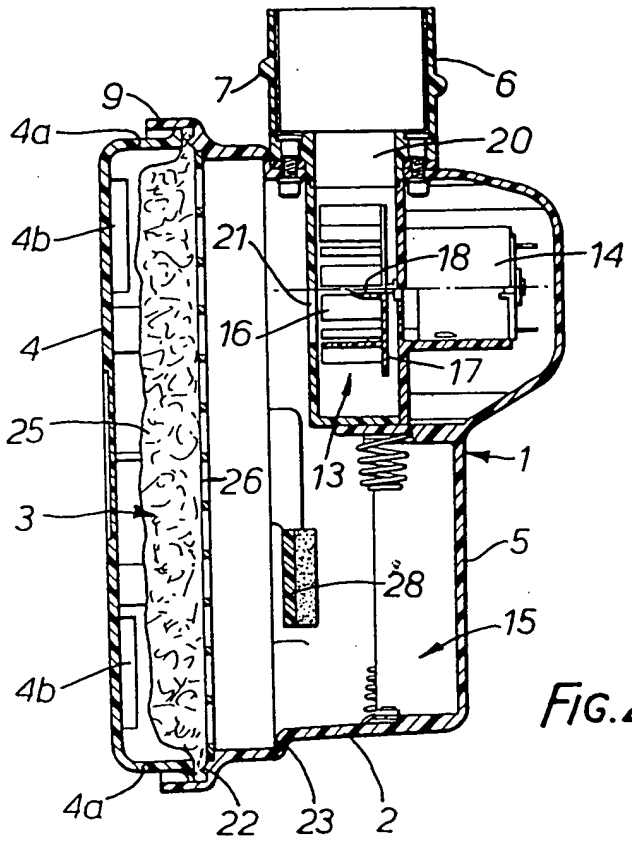

5
1
14
17
18
15
16
2
23
13
26
25
28
22
9
12
12
4a
3
4
4b
4b
4b
4a

FIG. 3.


9
7
6
4a
20
4b
21
18
14
16
4
17
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1
26
13
3
5
28
15
4b
4a
22
23
2

FIG. 2.

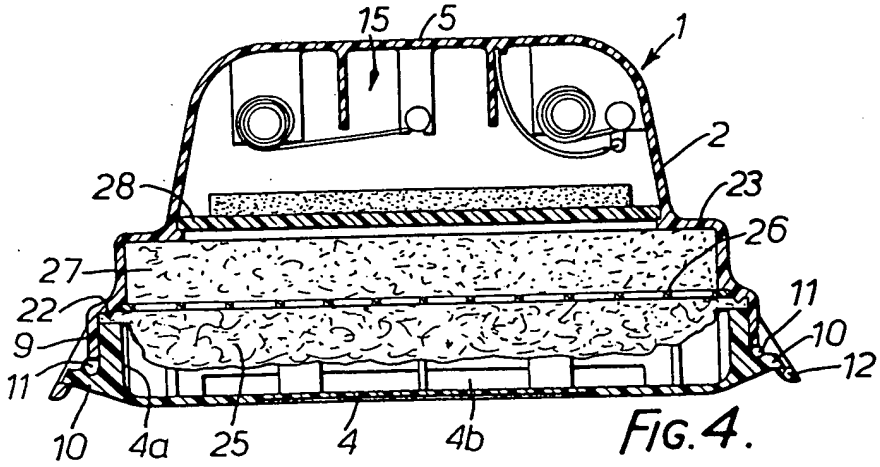
15
5
1
2
28
23
26
27
11
22
10
9
12
11
10
4a
25
4
4b

FIG. 4.

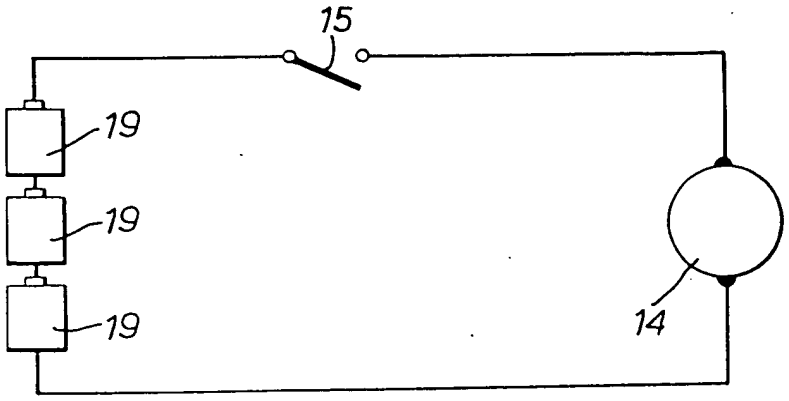

FIG. 5.

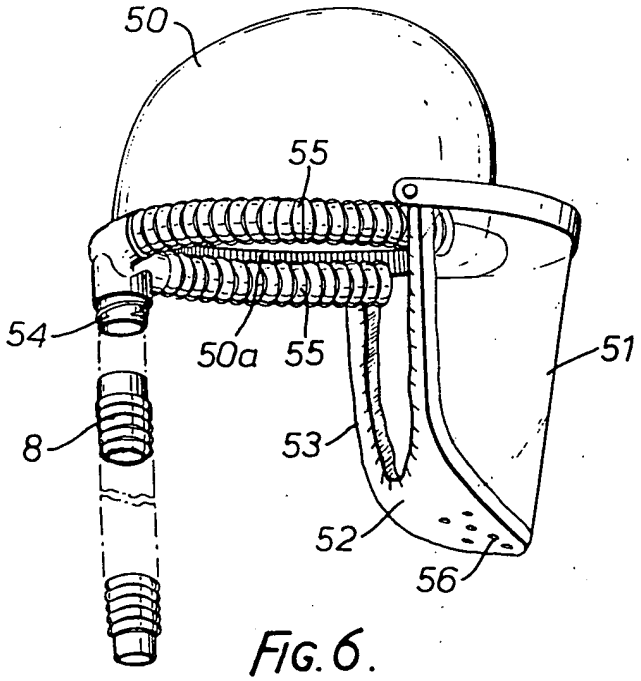

FIG. 6.

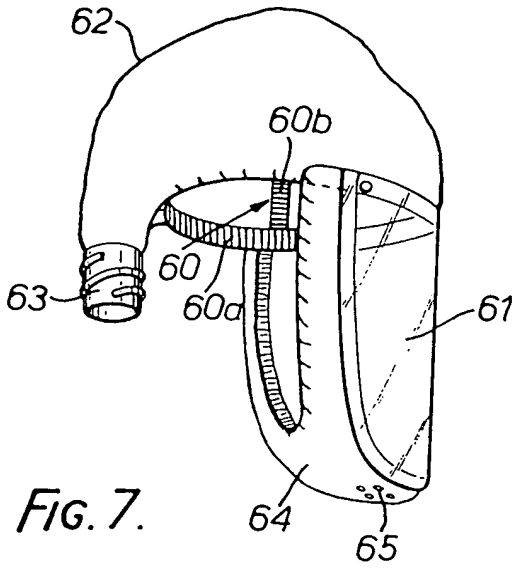

FIG. 7.

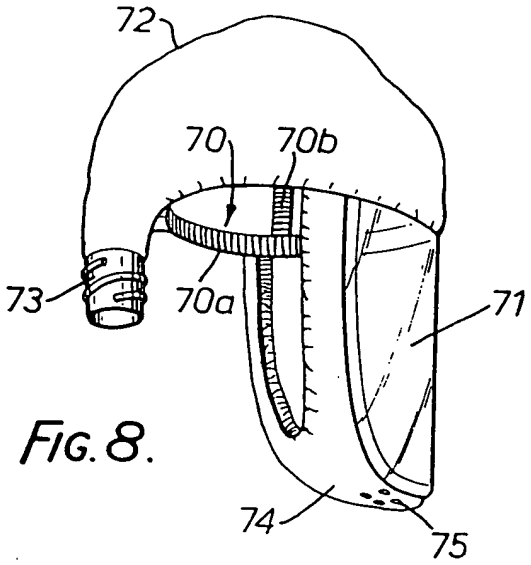

FIG. 8.

SPECIFICATION

Improvements in and relating to respirators

The present invention relates to improvements in and relating to respirators for providing the wearer with filtered air and for use in dusty or otherwise contaminated atmospheres.

Respirators of this type are well known and generally fall into two categories, being unpowered respirators with which the wearer, in inhaling, draws air through a filter, and power assisted respirators which include a pump which draws air through the filter and supplies it to the wearer.

Powered respirators have the advantage of requiring less or no effort on the part of the wearer which is a substantial advantage where the wearer is otherwise exerting himself. However because of the additional equipment required to power the respirator, such respirators are more expensive than unpowered respirators and additionally, because different industries and jobs have different requirements for the facepiece or headpiece of the respirator which extends over the nose and mouth of the wearer, the cost of powered respirators can be substantial if a different respirator has to be designed for each such set of circumstances.

According to one aspect of the present invention there is provided a powered air supply unit for a respirator for connection by a flexible hose to a facepiece or headpiece of a respirator for supplying air thereto, the unit comprising a housing defining a generally planar air inlet opening having a stepped periphery and an air outlet for connection to the flexible hose, filter means located in the stepped periphery of the opening, a removable protective cover over the opening permitting air to flow into the housing through the opening and for retaining the filter means in place in the opening, and pump means and a motor therefor mounted within the housing, the pump means having an inlet opening within the housing and an outlet connected to the housing outlet.

The pump means advantageously comprises a centrifugal pump and the motor is connected directly to the shaft of the pump, the motor advantageously being a d.c. motor to be powered by batteries which are also provided within the casing.

Preferably the casing is generally rectangular in plan with four side walls, the inlet opening being provided in one end and the protective cover being generally planar with apertures therein for permitting air to flow into the inlet opening and through the filter means to the inlet of the pump means.

The pump means and batteries are advantageously arranged side by side within the side walls of the casing with the outlet in the casing opening through one of the side walls and the axis of the shaft of the pump extending generally perpendicular to the cover. The end wall of the casing may be partially domed to accommodate the motor which is mounted on one end of the pump opposite the end at which the pump inlet opens.

The unit may be designed to be supported on the body of the wearer by a harness or belt with the cover against the body of the wearer.

The filter means may be selected to remove particulate material and/or gases or vapours from the incoming air and are provided as replaceable units, the cover being detachably mounted on the casing to permit access to the filter means for this purpose.

The periphery of the inlet opening in the casing may have a plurality of steps to accommodate a plurality of different filter units for different purposes, such for example as a first filter unit for removing particulate material and a second filter unit comprising for example cintered or granular carbon, for removing gases or vapours.

The above described air supply unit is useable with a variety of different face- or headpieces which merely require an attachment for connecting the flexible hose thereto at an appropriate point for supplying filtered air to the mouth and nose of the wearer.

The above described air supply unit may be associated with a headpiece comprising a head harness for mounting on the wearer's head and including a head band for encircling the wearer's head, a visor mounted on the head band to extend over the face of the wearer, and a flexible cover peripherally attached to the head band to create a space between it and the wearer's head, the cover including an inlet for connection by a flexible hose to the air supply unit for providing air thereto which, in use, will flow from the inlet into the space within the cover and then into the space between the visor and the wearer's face.

Advantageously the inlet is provided in the cover so as to be at the rear of the wearer's head. The head band may be arranged so that the air flowing from the space within the cover into the space between the visor and the wearer's head flows between the head band and the wearer's head. Alternatively the headpiece may comprise a protective helmet for mounting on the head of the wearer, a visor mounted on the helmet to extend in use over the face of the wearer, and flexible ducting encircling part of the periphery of the helmet, the ducting having an inlet for connection to a flexible hose for the supply of air thereto and an outlet opening into the space between the visor and the wearer's face.

Advantageously the inlet is provided intermediate the ends of the ducting adjacent the rear of the head and the ducting extends around the rear and sides of the helmet periphery and has two outlets both opening into the space between the visor and the wearer's face to either side of the wearer's face.

In either of the above described headpieces, the visor may be rigidly or pivotally attached to the head band or helmet respectively and a shroud or other sealing means may be provided around the periphery of the visor, if required, to prevent the ambient atmosphere entering around the visor. The visor or surrounding shroud may be provided with an exhale valve or perforations permitting air to flow out.

Alternatively, the air supply unit may be connected to a conventional headpiece comprising a protective helmet provided with a rearward inlet for air and internal ducts through which the air flows from the inlet to the wearer's face or which is arranged for air to flow to the wearer's face through a space within the helmet and defined between the helmet and the head

of the wearer.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a plan view of an embodiment of powered air supply unit according to the present invention, with the cover and filter means removed;

Figures 2, 3 and 4 are sections on the lines A-A, B-B and C-C respectively of Figure 1;

Figure 5 is a diagram of the electric circuit used in the unit of Figure 1; and

Figures 6, 7 and 8 are perspective diagrammatic views of embodiments of headpieces of respirators for use with the unit of Figure 1.

The powered air supply unit shown in Figures 1 to 5 comprises a housing 1, for example moulded of plastics material, which is generally rectangular in plan and comprises side walls 2 which are closed at one end by an end wall 5 and at the other end define an inlet opening 3 which is generally planar and is provided with a protective cover 4. The end wall 5 of the housing is partially domed for reasons which will appear. The housing 1 has an outlet 6 in one side wall 2 which is adapted, for example as shown is provided with a helical thread 7, for engagement with a flexible hose 8 (shown in Figure 6).

The cover 4 is generally planar and has a inturned flange 4*a* which is provided with lateral inlet apertures 4*b* permitting air to flow into the housing and through opening 3. The cover 4 is releasably engageable with the rest of the housing. As shown, the cover 4 is received within a peripheral wall 9 surrounding the opening 3 and is provided with lugs 10 which are resiliently engageable in apetures 11 provided in flanges 12 which project from wall 9 on opposite sides of the opening 3 and are resiliently flexible to enable the lugs 10 to engage in the apertures 11.

Mounted within the housing, there are a pump 13, a d.c. motor 14 for driving the pump, a battery housing 15 for receiving one or more batteries for energising the motor, and a circuit, shown diagrammatically in Figure 5, connecting the batteries to the motor. The pump 13 is a centrifugal pump and comprises impeller blades 16 which are cantilevered from a base plate 17 which extends generally parallel to the plane of opening 3 and cover 4. The pump 13 is provided with a driving shaft 18 formed integrally with the base plate 17 and which is connected directly to the driving shaft of the motor 14, motor 14 being accommodated in the domed portion of end wall 5 and arranged at that end of the pump 13 opposite the end provided with the axial inlet 21 of the pump. Inlet 21 opens into the housing and faces cover 4. The pump 16 also has an outlet 20 which is connected directly to the outlet 6 of the housing.

The pump 13 and motor 14 are thus arranged within the housing with their axes generally perpendicular to the plane of opening 3 and cover 4. The battery housing 15 is arranged beside the pump and motor, and as shown in Figure 5, the batteries 19 are connected in series with the motor 14 and a switch 15. The switch 15 is mounted adjacent the pump 13 and projects through a side wall of the housing so as to be accessible from the outside.

Also accommodated within the housing are filter means for filtering the air as it flows into the housing through the opening 3 and before it reaches the pump inlet 21. The filter means is accommodated in the opening 3 and to this end the ends of the side walls 2 defining the opening 3 are stepped, as at 22 and 23. The filter means is designed to be located in one or both of these steps and held in place by the cover 4. As shown in Figures 2 and 3, a single filter unit 25 is provided comprising layers of filter materials for removing particles and which is located in step 22. As shown, this filter unit 25 is supported by a mesh sheet 26, for example made of plastics material, which is seated in opening 3 adjacent step 22. The periphery of the filter unit 25 is trapped between the step and the periphery of the flange 4*b* of the cover 4 so as to seal it around its periphery and to hold it in place. In Figure 4, a second filter unit 27 is provided, for example comprising cintered or granular carbon for removing gases or vapours, and is located in step 23. This unit 27 is held in place by the mesh sheet 26 and filter unit 25, which is in turn held in place by the cover 4.

It will be appreciated that more than two units of filter materials may be provided, an appropriate number of steps in the periphery of the opening 3 being provided. Alternatively a single filter unit may be provided, seated on step 23 and occupying the entire space between step 23 and the main wall of the cover, the unit being held in place under a slight compressive force by the cover and sealed at its periphery by a compressible seal provided on step 23.

In use of the above described air supply unit, when the switch 15 is operated, the pump is driven to draw air through the inlet apertures 4*b*, opening 3, the filter means, e.g. units 25, 27, provided across the opening 3, and pump inlet 21, and to drive it out through pump outlet 20 and housing outlet 6 into the flexible hose 8 attached thereto. When it is required to replace the filter material, all that is needed is that the cover 4 be removed. This provides immediate access to all the filter material within the housing, which can then simply be removed and replaced. When it is required to change the batteries, the cover 4 is removed together with the filter means and a member 28 which releasably holds the batteries in place.

The unit is designed to be supported on the body of the wearer by a harness or belt which is attached to the casing by apertures 29 provided in flanges 12, and the unit is designed to be worn with the generally planar cover 4 against the body of the wearer.

The above described unit can be used with any suitable headpiece or facepiece which has an inlet suitable for connection to any flexible hose.

Three examples of headpieces which could be used with the powered air supply unit of Figures 1 to 5 are shown in Figures 6 to 8. The headpiece shown in Figure 6 comprises a rigid helmet 50 to be mounted on the head of the wearer and is adapted to be supported on the head by a harness 50*a*. A visor 51 is pivotally mounted on the front of the helmet and provided with a flexible shroud 52 around the periphery of the visor and adjacent parts of the helmet, which has an elasticated free edge 53 so as to positively engage around the wearer's face to seal the headpiece around the visor. For supplying air to the wearer's face, the helmet is provided at its periphery with flexible

ducting or a hose 55 which extends around the back and sides of the periphery of the helmet. At the back of the helmet, the ducting is provided with a T-piece provided with an inlet 54 adapted for connection to the flexible hose 8. The free ends of the hose 55 form outlets which open into the space between the visor and the wearer's face on either side of the wearer's face. Air from the inlet 54 thus flows through the hose 55 to the space within the visor. The shroud 52 may be provided with a one-way exhale valve or, as shown, a zone of perforations 56 for exit of air therefrom.

The headpiece shown in Figure 7 comprises a harness 60 comprising for example a head band 60*a* encircling the wearer's head and one or more straps 60*b* which extend over the wearer's head. A visor 61 is pivotally mounted on the head band 60*a*. A flexible cover 62 of flexible impervious material extends over the harness to cover the head of the wearer and is peripherally attached to the head band 60*a* to provide with the wearer's head a space. The cover is provided with an inlet 63 at the rear of the wearer's head for connection to the flexible hose 8 so that air flows from the inlet 63 into the space within the cover and there inflates the cover, and from the space within the cover to the space within the visor. Air flow passages may be provided to communicate air from the space within the cover to the space within the visor or air may simply flow between the head band and the wearer's head. As in the previous embodiment, the visor may be provided with a shroud 64 with an elasticated free edge and means, such as perforations 65, permitting exit of air from the space within the visor.

The headpiece of Figure 8 is similar in construction to that of Figure 7 and the same reference numerals, but with the prefix 7 rather than 6, have been used for like parts. However in this embodiment the visor 71 is fixedly mounted on the head band 70*a* of the harness.

It will be appreciated that the air supply unit of Figures 1 to 5 may be associated with a variety of other forms and constructions of headpieces or may be associated with facepieces which essentially only cover a part or the whole of the face of the wearer and are suitably fixed to the head of the wearer. Additionally, while as described above, the air supply unit is solely battery operated, the electrical circuit thereof may be adapted to permit battery charging from an external power supply and/or the motor to be energised by an external power supply, the batteries then serving as a stand-by power supply for use when the unit is disconnected from the external power supply.

CLAIMS

1. A powered air supply unit for a respirator for connection by a flexible hose to a facepiece or headpiece of a respirator for supplying air thereto, the unit comprising a housing defining a generally planar air inlet opening having a stepped periphery and an air outlet for connection to the flexible hose, filter means located in the stepped periphery of the opening, a removable protective cover over the opening permitting air to flow into the housing through the opening and for retaining the filter means in place in the opening, and pump means and a motor therefor mounted within the housing, the pump means having an inlet opening within the housing and an outlet connected to the housing outlet.

2. A unit as claimed in Claim 1, wherein the pump means comprises a centrifugal pump having a driving shaft which is connected directly to the motor.

3. A unit as claimed in either Claim 1 or Claim 2, wherein the motor is a d.c. motor, battery housing means are provided within the housing for receiving batteries, and circuit means are provided for connecting the batteries to the motor.

4. A unit as claimed in any one of the preceding claims, wherein the housing is generally rectangular in plan and comprises side walls, the inlet opening being defined by one end of the side walls, the other end of the side walls being closed by an end wall.

5. A unit as claimed in Claim 4, wherein the protective cover is generally planar and extends generally perpendicularly to the side walls, and is provided with inlet apertures permitting air to flow to the opening.

6. A unit as claimed in any one of the preceding claims, wherein the cover is provided with an inturned flange for bearing against the periphery of the filter means to seal the periphery of the filter means.

7. A unit as claimed in any one of the preceding claims, wherein seal means are provided in the periphery of the inlet opening for sealing the periphery of filter means.

8. A unit as claimed in any one of Claims 4 to 7, wherein the pump means is arranged within the housing with its driving shaft generally perpendicular to the plane of the opening, the inlet of the pump means facing the inlet opening, the outlet of the housing being provided in a side wall of the housing.

9. A unit as claimed in any one of Claims 4 to 8, wherein the motor is mounted at one end of the pump means opposite that provided with the pump inlet, and the battery housing is arranged beside the pump means.

10. A unit as claimed in any one of the preceding claims, wherein a plurality of steps are provided in the periphery of the inlet opening, the filter means comprising a plurality of units of filter materials, each unit being received in a respective step.

11. A unit as claimed in Claim 10, wherein the filter means comprises a first unit of filter material for removing particulate material from the air and a second unit of filter material for removing gaseous products or vapour from the air.

12. A unit as claimed in any one of the preceding claims, including a supporting member permeable to air which is provided across the inlet opening for supporting the or some of the filter means.

13. A powered air supply unit substantially as herein described with reference to Figures 1 to 5 of the accompanying drawings.

14. A respirator comprising a facepiece of headpiece for covering at least the nose and mouth of the wearer and having an air inlet for supplying air to the nose and mouth of the wearer, and a flexible hose connected to the air inlet, characterised by a powered air supply unit as claimed in any one of the preceding claims, the flexible hose being connected to the housing outlet.

15. A respirator comprising a powered air supply unit as claimed in any one of the preceding claims, a flexible hose, and a headpiece substantially as herein

described with reference to any one of Figures 6, 7 and 8 of the accompanying drawings.

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